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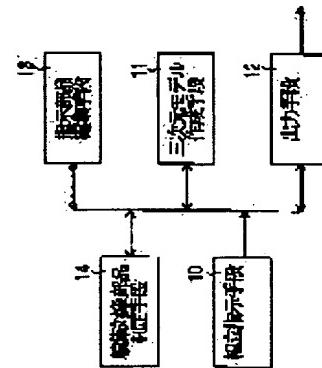
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(54) THREE-DIMENSIONAL MODEL PRODUCING DEVICE/METHOD

(57)Abstract:

PURPOSE: To easily, efficiently and quickly produce a more actual three-dimensional model of high quality in reference to a three-dimensional model producing device/method which produces and displays a three-dimensional product model.

CONSTITUTION: The assembling instructions are successively produced for each of parts models which are assembled into a three-dimensional product model (10). Then it is decided whether the parts models instructed to be assembled are equal to the editing object parts (14). If so, the relevant assembled parts model is edited based on the relation between the unassembled and assembled states or the relation with other relative parts models (13). Then the parts model instructed in an assembling mode and the edited parts model are assembled together into a three-dimensional parts model based on the attribute information on each parts model and the inter-parts assembly information (11).



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CLAIMS

[Claim(s)]

[Claim 1] An assembly directions means which should be assembled to the product model of three dimensions to direct an assembly one by one for every components model (10), A components judging means for edit by which said components model to which directions of an assembly were carried out by said assembly directions means (10) judges that they are the components for edit (14), When judged with the components models which directed the assembly being the components for edit A directions components edit means to edit into the components model after an assembly about the components model concerned based on relation with other components models with which before and behind the assembly is related, or it is related before and behind (13), A three dimensional object model creation means to assemble the components model edited by the components model which said assembly directions means (10) directed, and said directions components edit means (13) based on the attribute information on each part article, and the assembly information between components, and to create the product model of three dimensions (11), The three dimensional object model listing device characterized by having the output means (12) which outputs a display etc. about the product model of the three dimensions created by the three dimensional object model creation means (11).

[Claim 2] A components assignment means assembled by the product model of three dimensions to perform sequential assignment for every components model (20), A components judging means for edit by which said components model specified by said components assignment means (20) judges that they are the components for edit (14), When judged with the specified components models being the components for edit A specification part article edit means to edit into the components model after an assembly about the components model concerned based on relation with other parts to which before and behind the assembly is related, or it relates before and behind (23), While creating the product model of three dimensions based on the attribute information on each part article, and the assembly information between components The components model judged by said components judging means for edit (14) among the components models assembled by the product model concerned to be the components for edit The three dimensional object model creation means replaced with the components model edited by said specification part article edit means (23) (21), The three dimensional object model listing device characterized by having the output means (12) which outputs a display etc. about the product model created by the three dimensional object model creation means (21).

[Claim 3] An assembly is directed one by one for every components model which should be assembled to the product model of three dimensions (S1). When it judges whether the components models with which directions of an assembly were carried out are the components for edit (S2) and is judged with the components models with which directions of an assembly were carried out being the components for edit About the components model concerned, it is based on relation with other components models with which before and behind the assembly is related, or it is related before and behind. (S4) which edits the components model after an assembly (S3), incorporates the components model and the edited components model directed

on the occasion of an assembly based on the attribute information on each part article, and the assembly information between components, and assembles the product model of three dimensions — the three dimensional object model creation approach characterized by things. [Claim 4] Sequential assignment is performed for every components model assembled by the product model of three dimensions (S11). When it judges whether the specified components models are the components for edit (S12) and is judged with the specified components models being the components for edit About the components model concerned, it is based on relation with other components with which before and behind the assembly is related, or it is related before and behind. The inside of the components model of the product model of the three dimensions which edited into the components model after assembling (S13), and were created based on the attribute information on each part article, and the assembly information between components, The three dimensional object model creation approach characterized by what the components model judged to be the components for edit is transposed for to the edited components model (S14).

[0001]

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[Industrial Application] This invention relates to a three dimensional object model listing device and an approach, and relates to the three dimensional object model listing device and approach of creating and displaying the product model of three dimensions especially. This invention is the field which carries out a product development, and is useful to the increase in efficiency of an assembly simulation activity in a design section with the 3-dimensional CAD of workstation level in the design of a product model and the improvement in precision of the interference check activity on an assembly model, and a manufacturing department.

[0001]

[Description of the Prior Art] Conventionally, there was a three dimensional object model listing device by 3-dimensional CAD as shown in drawing 12. The 3-dimensional CAD concerning the conventional example has a three-dimensional-object-model creation means 91 create the product model of three dimensions based on the attribute information on each part article which was inputted by data input means 94 perform the entry of data and the directions about the product model of three dimensions, and the data input means 94 concerned, or was stored beforehand, or the assembly information between components, and the output means 92 which output the display of the product model of the created three dimensions etc., as shown in this drawing.

[0002]

[Problem(s) to be Solved by the Invention] Now, in the design by the 3-dimensional CAD concerning the conventional example, when the three-dimensions configuration of a simple substance components model deformed after an assembly, the components model which an operator deforms needed to be looked for out of the product model, the data after the deformation needed to be separately inputted with said data input means 94, and the model itself needed to be remade with said three dimensional object model creation means 91. Or the model after deformation is beforehand set as *****, the components model which deforms after an assembly is looked for out of a product model, and the activity which chooses and exchanges the components model which suited the conditions of the deformation in the components model before deformation is needed. Therefore, it had the trouble that a user's burden increased.

[0003] Then, in order to solve the trouble of the conventional technique, the components kind (components kind for edit) which changes the configuration of a model before and after an assembly judges automatically, the components model after an assembly edits automatically to the components model which changes the configuration of a model before and after an assembly based on relation with other components models with which before and after the assembly is related, or it is related before and after, and the product model of three dimensions makes create in this invention. The optimal configuration where the conditions in the part in which the components model which changes before and after an assembly by this is attached were followed is made to embody, and it carries out like the case where a check is actually assembled, and is made for the purpose of creating the three dimensional object model of the high quality more near reality easily, efficiently, and quickly.

[0004]

[Means for Solving the Problem] In order to solve the above technical technical problem, the first invention An assembly directions means 10 which should be assembled to the product model of three dimensions as shown in drawing 1 to direct an assembly one by one for every components model, A components judging means 14 for edit by which said components model to which directions of an assembly were carried out by said assembly directions means 10 judges that they are the components for edit, When judged with the components models which directed the assembly being the components for edit A directions components edit means 13 to edit into the components model after an assembly about the components model concerned based on relation with other components models with which before and behind the assembly is related, or it is related before and behind, A three dimensional object model creation means 11 to assemble the components model edited by the components model which said assembly directions means 10 directed, and said directions components edit means 13 based on the attribute information on each part article, and the assembly information between components, and to create the product model of three dimensions, About the product model of the three dimensions created by the three dimensional object model creation means 11, it has the output means 12 which outputs a display etc.

[0005] A components assignment means 20 assembled by the product model of three dimensions as the second invention was shown in drawing 2 to perform sequential assignment for every components model, A components judging means 14 for edit by which said components model specified by said components assignment means 20 judges that they are the components for edit, When judged with the specified components models being the components for edit A specification part article edit means 23 to edit into the components model after an assembly about the components model concerned based on relation with other parts to which before and behind the assembly is related, or it relates before and behind, While creating the product model of three dimensions based on the attribute information on each part article, and the assembly information between components The components model judged by said components judging means 14 for edit among the components models assembled by the product model concerned to be the components for edit It has the three dimensional object model creation means 21 replaced with the components model edited by said specification part article edit means 23, and the output means 12 which outputs a display etc. about the product model created by the three dimensional object model creation means 21.

[0006] As shown in drawing 3 , the third invention for every components model which should be assembled to the product model of three dimensions Direct an assembly one by one (S1), and it judges whether the components models with which directions of an assembly were carried out are the components for edit (S2). When judged with the components models with which directions of an assembly were carried out being the components for edit About the components model concerned, it is based on relation with other components models with which before and behind the assembly is related, or it is related before and behind. (S4) which edits the components model after an assembly (S3), incorporates the components model and the edited components model directed on the occasion of an assembly based on the attribute information on each part article, and the assembly information between components, and assembles the product model of three dimensions -- they are things.

[0007] As shown in drawing 4 , the fourth invention for every components model assembled by the product model of three dimensions When sequential assignment is performed (S11), it judges whether the specified components models are the components for edit (S12) and it is judged with the specified components models being the components for edit About the components model concerned, it is based on relation with other components with which before and behind the assembly is related, or it is related before and behind. It is what the components model judged among the components models of the product model of the three dimensions which edited into the components model after assembling (S13), and were created based on the attribute information on each part article and the assembly information between components to be the components for edit is transposed to the edited components model for (S14).

[0008] Here, it says making "edit" deform into the configuration in case a product model is

assembled, after assembling the configuration before assembling. For example, when combining the plate related in total in the head of a rivet, it says making it deform into the configuration after closing the configuration before assembling. In case "the components for edit" assembles a product model, they means the components with which the back before assembling differs from each other in a configuration. For example, there is a circuit in which the member which includes fluids, such as indirect transmission members, such as a belt of elastic members, such as a rivet, a bolt and a nut or bond part material like solder, a spring, a washer, or rubber, and a power transfer system, and mercury, the plasticity member which deforms according to assembly, a flexible member, or lead wire was prepared.

[0009] "The relation before and behind the assembly" means the difference between the configuration before edit, and the configuration after edit, and "other related components" is components with relation, such as components for edit, and contact, and it calls it an "associated part" below. For example, when the components for edit are rivets, the tabular components of two or more sheets combined with the rivet concerned are said.

[0010]

[Function] Then, the first invention and invention of the third are explained. As shown in drawing 1 and drawing 3, in order to assemble to a product model one by one, it directs in the screen superiors of the output means 12 about the components model which forms a product model with said assembly directions means 10 at step S1. Said components judging means 14 for edit judges that they are the components for edit for said every component model which had directions of an assembly with said assembly means 10 in that case.

[0011] At step S2, when judged with the components models which directed the assembly being the components for edit, said directions components edit means 13 edits the components model after an assembly about the components for edit concerned based on the relation before and after the assembly, or relation with an associated part. At step S3, while creating the components model directed on the occasion of an assembly based on the attribute information on each part article for [which was given] creation, and the assembly information between components, the created components model or the edited components model is incorporated, and a product model is assembled. The assembled product model will be displayed on a screen by said output means 12, or a printout will be carried out.

[0012] Then, an operation of the second invention and the fourth invention is explained. If it is in this invention as shown in drawing 2 and drawing 4, unlike what was mentioned above, it is step S11 and sequential assignment is performed for every components model assembled by the product model of three dimensions with said components assignment means 20. Then, the specified components model judges that they are the components for edit with said components judging means 14 for edit at step S12.

[0013] When judged with the specified components models being the components for edit at step S13, it edits into the components model after assembling about the components model concerned based on the relation before and behind the assembly, or relation with an associated part. The components model judged among the components models of the assembled product model at step S14 to be the components for edit is transposed to the edited components model. As for the replaced product model, outputs, such as a display, are made from said output means 12.

[0014]

[Example] Then, the example of this invention is explained based on a drawing. Drawing 5 shows the configuration block diagram about the three dimensional object model listing device and approach concerning this example. As shown in this drawing, in this example as hardware CPU and memory 51 which perform various control about the three dimensional object model listing device concerned, The output means 52 which outputs a display etc. about data, such as a created three dimensional object model, The keyboard 54 grade and the input means 54 in which a handwriting input is possible of performing tablet 54a and an entry of data with the file 53 in which various kinds of data are stored, and the function in which an operator performs assignment and directions various in a screen top are connected by the bus.

[0015] As shown in drawing 5, in CPU and memory 51 With the 3-dimensional CAD radical

headquarters 31 with the function realized by the fundamental program used in case a three dimensional object model is created. The screen-display control section 32 which performs control displayed on display 52a about the three dimensional object model and the various information which were created. The retrieval section 33 which searches the components for edit to the components library section 41 for edit later mentioned with directions. The edit activation section 34 which directs activation of edit, and the configuration count section 35 which performs count of a configuration. The configuration creation section 36 which creates a geometric model, and the conversation control section 37 which displays a message or reads selection and key input information in an operator. Control of connection between the 3-dimensional CAD system 55 and the application section 56 customizable by the user side. That is, it has the external-interface section 38 with the function which takes out and processes outside the model information (attribute of a configuration, a location, a color, and others) recorded on the internal file of the 3-dimensional CAD system 55, and is again returned to the interior.

[0016] Moreover, for said output means 52, it has display 52a and printer 52b which outputs the list of count results with a parameter. In said file 53, it has the components information database 39, the assembly information database 40, and the components library section 41 for edit. Here, information, such as an object components name, a formula, and the configuration original form, is stored in the components library section 41 for edit concerned.

[0017] Then, the first example is explained. The three dimensional object model listing device concerning the first example is constituted as shown in drawing 6 using the device shown in drawing 5 mentioned above. If it is in the three dimensional object model listing device concerning this example, said components model which had directions of an assembly by said tablet 54a equivalent to an assembly directions means which should be assembled to the product model of three dimensions to direct an assembly one by one for every components model, and the tablet 54a concerned has a components judging means 64 for edit to judge that they are the components for edit.

[0018] Moreover, the three dimensional object model listing device concerning this example When judged with the components models which directed the assembly being the components for edit A directions components edit means 63 to edit into the components model after an assembly about the components model concerned based on the relation before and behind the assembly, or relation with an associated part model. It is based on the attribute information on each part article, and the assembly information between components. The 3-dimensional CAD system 55 equivalent to a three dimensional object model creation means to assemble the components model edited by the components model which tablet 54a which is said assembly directions means directed, and said directions components edit means 63, and to create the product model of three dimensions. About the product model of the three dimensions created by the three dimensional object model creation means etc., it has display 52a which displays.

[0019] Furthermore, for said components judging means 64 for edit, it has said retrieval section 33 and the components library section 41 for edit, and has the edit activation section 34, the configuration count section 35, the configuration creation section 36, and the conversation control section 37 for said directions components edit means 63. Moreover, said 3-dimensional CAD system 55 is equivalent to said components information database 39, the 3-dimensional CAD radical headquarters 31, the assembly information database 40, the screen-display control section 32, and an external interface 38, and the application section 56 has said directions components editorial department 63 and the components judging section 64 for edit.

[0020] Then, actuation of the three dimensional object model listing device and approach concerning the first example is explained based on drawing 7. Among the flow chart of drawing 7, steps P1-P5 surrounded by the dotted line are the parts about the function of this example, and others are common functions also in the usual 3-dimensional CAD.

[0021] (a) from which the components information about the components model chosen from the components information database 39 will be read if there are directions of selection of the components model which an assembly is started and is set as the object of an assembly one by one by said tablet 54a etc. as shown in drawing 7. Then, (b) which starts the retrieval section

33 of said components judging means 64 for edit via an external interface 38, and refers to step P1 by making into a keyword nomenclature chosen as the components library section 41 for edit.

[0022] Here, "nomenclature" is an identifier which identifies the component for edit concerned systematically assigned to components for edit, such as a rivet, under the following regulations, and the facilities of retrieval are taken into consideration. For example, if nomenclature is a rivet, it is "LIB1XY." Here, three characters of the beginning in the nomenclature of "OOOOOO" have the circuit which expresses, the class, i.e., the components kind, of components, for example, has a member using fluids, such as indirect transmission members, such as elastic members, such as bond part material, such as a rivet, a bolt and a nut, and solder, a spring, a washer, and rubber, a belt, and a chain, a plasticity member, a flexible member, and mercury, or lead wire.

[0023] Moreover, the single digit as follows is the classification in the same components kind, for example, when a components kind is a rivet, there are a round-head rivet and a countersunk rivet. Furthermore, it follows, the following two characters are watch, and in the same classification, when a classification is still more nearly required, they are added. By using this nomenclature, it can judge easily that they are the components for edit.

[0024] Retrieval result (c) Since the usual assembly processing is sufficient as long as it is not the components for edit, it progresses to step P6 and what built the components model concerned into the three dimensional object model is displayed on said display 52a through the screen-display control section 32 of the 3-dimensional CAD system 55.

[0025] On the other hand, it is (f) which progresses to step P2 and once asks whether edit said retrieval section 33 into the screen of display 52a to an operator through the screen-display control section 32 of the 3-dimensional CAD system 55 through the conversation control section 37 when judged with the components for edit at step P1.. Since this may have a good direction with the original form, it is for putting in a check for a sense depending on the case.

[0026] It is (g) as a result of an inquiry. When it is answered that it does not edit, it is (f) again. It goes, the notice of edit evasion is taken out to an operator, it progresses to step P6, and the components concerned are stood by till an assembly and the next components selection to a three dimensional object model. The case of a round-head rivet is shown in drawing 8 as an example of such components for edit. This drawing (**) is the round-head rivet 1 in which the configuration in front of caulking is shown, this drawing (**) shows the configuration which carried out round-head caulking of the round-head rivet 1, and this drawing (Ha) shows the configuration which carried out pan caulking. In addition, the sign 2 and sign 3 of this drawing (**) and (Ha) express each components which carried out caulking **** association, and the so-called "component of related others." Thus, a rivet changes a configuration depending on the caulking front of a rivet, after, and the method of caulking, when assembling to a finished-product model.

[0027] On the other hand, when are edited at step P2 and it chooses It progresses to step P3 and is (f) from the conversation control section 37. It goes and an operator is received. On the screen of said display 52a It is (h) at the same time it urges selection of the sign 2 and sign 3 which were shown in drawing 8 which is "other related components". It goes, the edit activation section 34 is started, and it is (i). The associated part information which went and was directed from the components information database 39 is read. Or an operator inputs numeric values, such as the numeric values L1, L2, and Ld about the sign 2 and sign 3 of drawing 8 which are other related target components.

[0028] The related components information read at step P4 is (j). It goes, required dimension data are incorporated to the configuration count section 35, and the configuration count section 35 is (k) from the edit activation section 34. It minds and is (m) about a formula from the components library section 41 for edit. It minds, and it incorporates and configuration count is performed.

[0029] As shown in drawing 8, count is automatically transposed to the round-head rivets 1a and 1b processed based on the configuration of the rivet of this drawing (b) so that it considers beforehand each thickness L1 and L2 of the components 2 which are associated parts, and

components 3, and it may become the configuration of the head as shown in this drawing (Ha) in case of round-head caulking, if it is pan caulking like (**) of drawing 8 .

[0030] Specifically, it carries out as follows. As shown in drawing 8 , L1 and L2 are read for the thickness equivalent to the configuration original-form data of an associated part, respectively. Change of the die length by deformation is as follows. That is, in round-head-rivet 1a which carried out round-head caulking, the die length Lb of the drum is $Lb=L1+L2$. -- Formula 1

[0031] On the other hand, the thickness which also sees the pan for caulking of an associated part 3 when the die length Lc of the drum sets thickness of an associated part to L1 and L2, respectively in round-head-rivet 1b which carried out pan caulking is considered, and it is $Lc=L1+L2-Ld$. -- It calculates using a formula 2. This conditional expression is beforehand registered in said components library section 41 for edit.

[0032] At step P5, it is (n) about said configuration original-form data. It is (p) about the count result obtained by said configuration count section 35 while minding and incorporating from the components library section 41 for edit. Going, the obtained configuration creation section 36 creates the last configuration. In the case of the round-head rivet which mentioned creation of a configuration above, round-head caulking differs in the configuration of the head from pan caulking as follows, respectively. About round-head-rivet 1a of round-head caulking, it is carried out by creating the configuration which carried out the mirror from the configuration of the opposite side of a round-head rivet, and, in the case of pan caulking, is carried out by generating a joint configuration with the configuration to which countersinking of the associated part 3 was carried out.

[0033] The conditions of the configuration generation concerned are also made to register into said components library section 41 for edit in which the reference in 3-dimensional CAD is possible beforehand. The original form of a deformation model is prepared beforehand, "processing which creates a model configuration" serves as a model which can assign only each dimension value here, and a configuration can be easily created only by applying the numeric value of the result calculated and obtained at step P4. The last configuration created at step P6 is (q). It goes, the 3-dimensional CAD radical headquarters 31 is passed, and an assembly is performed using the part shape concerned. The above step P1 – step P6 are repeated until an assembly is completed.

[0034] Then, the second example is explained. Unlike the first example, the second example starts the program which edits to the three dimensional object model which the assembly completed. Tablet 54a which was assembled by the product model as the three-dimensions listing device concerning the second example was shown in drawing 9 , which performs sequential assignment for every components model and which is a components assignment means, A components judging means 74 for edit by which said components model specified by the tablet 54a concerned judges that they are the components for edit, When judged with the specified components models being the components for edit, it has a specification part article edit means 73 to edit into the components model after an assembly about the components for edit concerned based on relation with other parts to which before and behind the assembly is related, or it relates before and behind.

[0035] Moreover, the three dimensional object model listing device concerning the second example While creating the product model of three dimensions based on the attribute information on each part article, and the assembly information between components The components model judged by said components judging means 74 for edit among the components models assembled by the product model concerned to be the components for edit It has display 52a which displays about the product model of the three dimensions created by the 3-dimensional CAD system 55 which is a three dimensional object model creation means replaced with the components model edited by said specification part article edit means 73, and the 3-dimensional CAD system 55 etc.

[0036] Then, actuation concerning the second example is explained based on drawing 10 . as show in drawing 10 , when the program which edit to the product model of the three dimensions which the assembly once completed start by said tablet 54a etc. except for the edit after assembly, the retrieval section 33 which be said components judging section 56 for edit at step

P11 be a path (a), and a path (b) the components information on the components model which mind and constitute the product model of three dimensions from an assembly information database 40 read in order.

[0037] When it reads, it confirms whether have finish reading all data at step P12. When the components data which wait for read-out still exist, the components data with which the retrieval section 33 of the components judging means 74 for edit concerned was read judge that they are the components for edit at step P13.

[0038] Here, the judgment of being the components for edit by the retrieval section 33 is performed as follows. Said nomenclature contained in the components information read from said assembly information database 40 (b) It carries out by making it a keyword and searching the components library section 41 for edit, and carries out by sending said nomenclature to the components library section 41 for edit, and collating whether they are (c) and the components for edit.

[0039] When judged with their not being the components for edit, the retrieval section 33 is (a) about the following components. In order to go to read through a path, it returns to step P11. It is (e) in order to look for selection of whether to edit to an operator at step P14, when judged with their being the components for edit at step P13. Through a path, the edit activation section 34 is started and it is (f). The conversation control section 37 is started by course, and it is (g). An operator is asked for directions of whether to edit on the screen of display 52a of the 3-dimensional CAD system 55 through a path.

[0040] Preferably [when selection of not editing is made], as shown in step P19, it is (i) from the conversation control section 37. It is [whether it goes, returns to the edit activation section 34 and forces to terminate, and] (f). Or (g) It goes, displays again and waits for a reply of an operator. It is (i) when it is answered that it forces to terminate. (h) It goes, that is notified to the edit activation section 34, and edit processing actuation is ended. When it is answered that it does not force to terminate, it moves to step P11 at read-out actuation of return and the following data. When selection of editing is made at step P14, the dimension (thickness) of said target associated part is read in the edit activation section 34 to the components information database 39 at step P15, and it is (j). (k) which records the result .

[0041] At step P16, said edit activation section 34 starts the configuration count section 35, and is (m) about object components (in this case, a rivet configuration, a formula, etc.) from the components library section 41 for edit similarly. And (n) It minds and a deformation parameter is made to calculate based on the acquired information. At step P17, it is delivery (q) to the configuration creation section 36 about the result. The configuration after deformation is generated.

[0042] At step P18, if a configuration is completed by the configuration creation section 36, it will access from the edit activation section 34 to the assembly information database 40 of the 3-dimensional CAD system 55, and it is (r). The configuration creation section 36 is a path (s) about the model before modification, and the configuration after modification. It uses, reads and permutes. As here shows a "permutation" to the drawing 11 (**), it says constituting A by editing by the function (specification part article edit means) concerning this example, when assembling by B, C, and D, as "D" is changed to "E" and it is shown in this drawing (b).

[0043] As an A model, as shown in this drawing (**), as shown in this drawing (**), the configuration before the edit which consists of an associated part B (plate-like part material), an associated part C (plate-like part material), and components D (rivet) still more specifically It says transposing to the rivet E after the deformation which shows the rivet before the deformation which shows the components D of them in this drawing (Ha) to this drawing (d) in the location of the components D in A model of this drawing (e). In addition, it moves from said components judging means 74 for edit to read-out of the following data after step P18.

[0044] Although the above explanation explained the rivet about the case of the plate-like part material of two sheets as an associated part as components for edit, it cannot be overemphasized that it is possible also about the plate-like part material of three or more sheets. Moreover, it is applied also to the tabular member as the case of the bolt and nut which are in the integrated state after assembly other than a rivet to the bolt and nut before

assembly, and an associated part. In addition, it is applied also to soldering, welding, and association by bending.

[0045] Furthermore, it is applied also to elastic members, such as a spring which deformed after assembling, a washer, and rubber, to elastic members, such as a spring and a washer without deformation before assembly, and rubber. In addition, it is applied to the member which is applied also to the indirect transmission member of a power transfer system, and includes fluids, such as a flexible member, and a plasticity member, a liquid, as components for edit, or a circuit with lead wire. If it is in each example as explained above, he is trying to have the conditional expression of the formation of a form status change of the components for edit with which configurations differ before and after assembly etc. in said components library section for edit. Therefore, while updating and deletion of the components for edit are easy, and it is user-friendly and processing at a high speed, the high three dimensional object model of setting quality is offered.

[0046] moreover, in case these components are assembled, making the optimal configuration where of the conditions in the part in which a deformation configuration is extracted and attached automatically were followed embody cuts by adding the unified nomenclature to each component for edit, registering the conditional expression at the time of the shape of a basic form, and deformation beforehand as a key of retrieval of the nomenclature concerned, and using the unique components name which it is at the registration time and was determined. Therefore, the judgment of being the components for edit can be made easy, and it can process at a high speed. If it is in each example as explained above, when a three-dimensional product model is created using 3-dimensional CAD, In case each detail-part model is collected and assembled, the principle of a form status change form is beforehand programmed to the components for edit with which configurations differ by the case where it is incorporated with the case where it exists alone, and it is an assembly phase. The principle is followed, the configuration after an assembly is calculated automatically, a model is transformed, and a position is made to embody. When this creates a product model by 3-dimensional CAD, the time and effort of actuation is also saved by becoming the expression near a more nearly actual product and moreover realizing automatically.

[0047]

[Effect of the Invention] He is trying to embody automatically the same configuration as what was actually assembled by editing as mentioned above about the components for edit with which configurations differ before and after the assembly of a components model in the case of creation of the product model of the three dimensions by 3-dimensional CAD according to this invention. Therefore, since it can carry out like the case where the interference check and gap check which are produced when a components model is assembled to a product model are actually assembled, by giving the remedy of a design, exchange of a more exact design is enabled, operability is easily good and creation of the three dimensional object model of the high quality more near reality can be performed efficiently and quickly.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

- [Drawing 1] The principle block diagram of the first invention
- [Drawing 2] The principle block diagram of the second invention
- [Drawing 3] The principle flow chart of the third invention
- [Drawing 4] The principle flow chart of the fourth invention
- [Drawing 5] The configuration block diagram concerning an example
- [Drawing 6] The block diagram concerning the first example
- [Drawing 7] The flow chart concerning the first example
- [Drawing 8] Drawing showing the example of the components for edit concerning the first example
- [Drawing 9] The block diagram concerning the second example
- [Drawing 10] The flow chart concerning the second example
- [Drawing 11] Drawing showing the example of a permutation concerning the second example
- [Drawing 12] The block diagram concerning the conventional example

[Description of Notations]

- 10 Assembly Directions Means
- 11 21 Three dimensional object model creation means
- 12 52 Output means
- 13 Directions Components Edit Means
- 14 Components Judging Means for Edit
- 20 Components Assignment Means

[Translation done.]

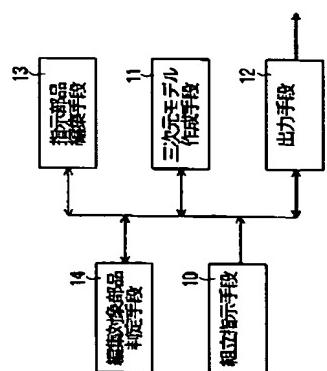
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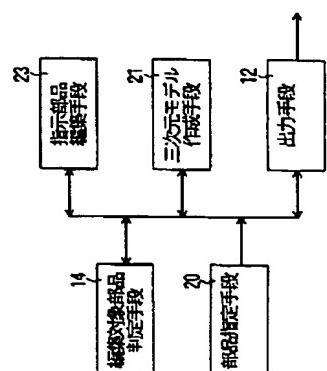
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DRAWINGS

[Drawing 1]
第一の発明に係る原理ブロック図

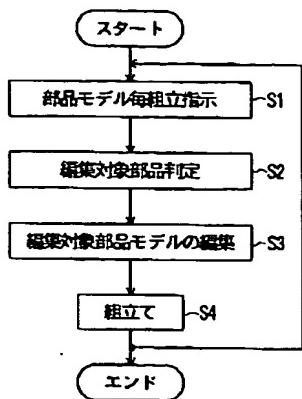


[Drawing 2]
第二の発明に係る原理ブロック図

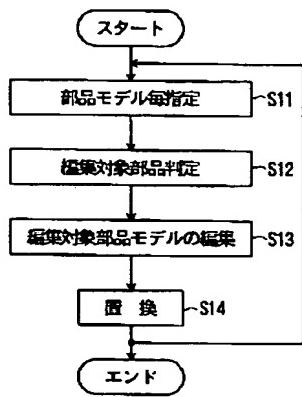


[Drawing 3]

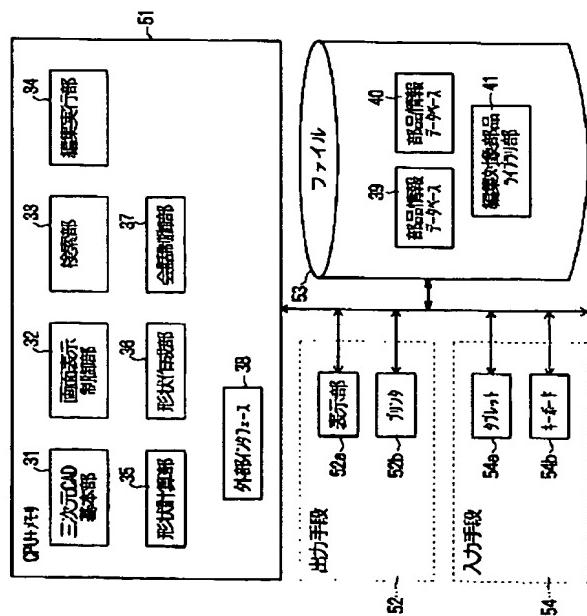
第三の発明に係る原理流れ図



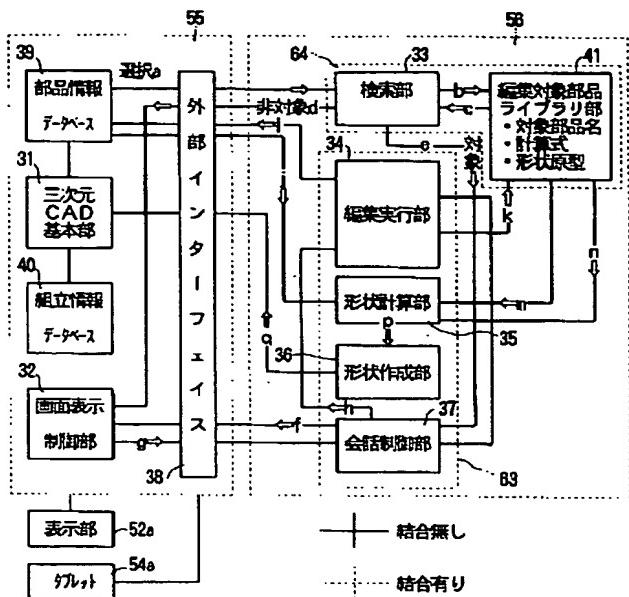
[Drawing 4]
第四の発明に係る原理流れ図



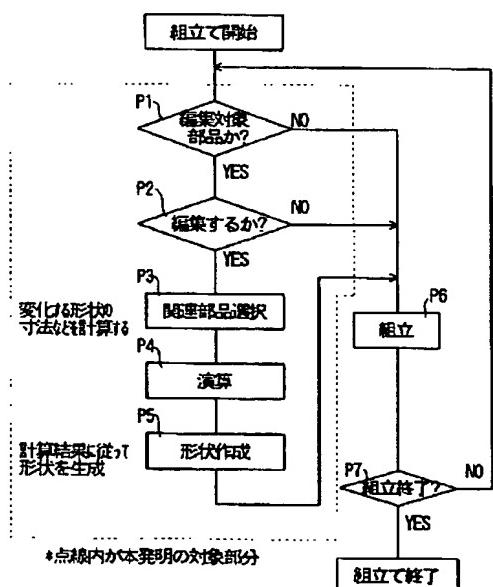
[Drawing 5]
実施例に係る機器構成ブロック図



[Drawing 6]
第一の実施例に係るブロック図

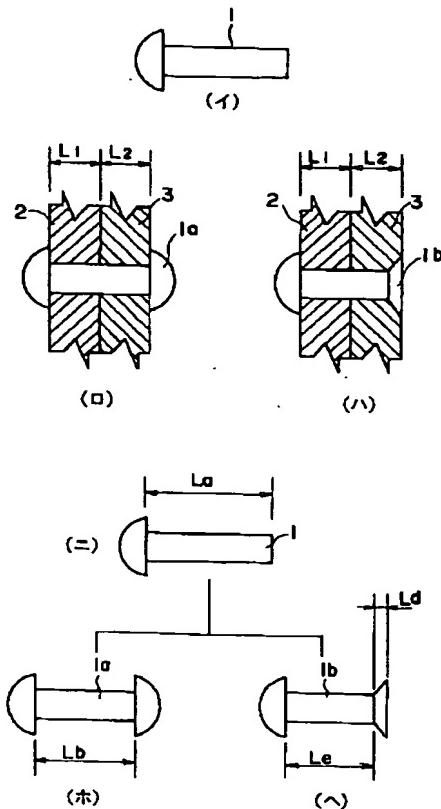


[Drawing 7]
第一の実施例に係る流れ図

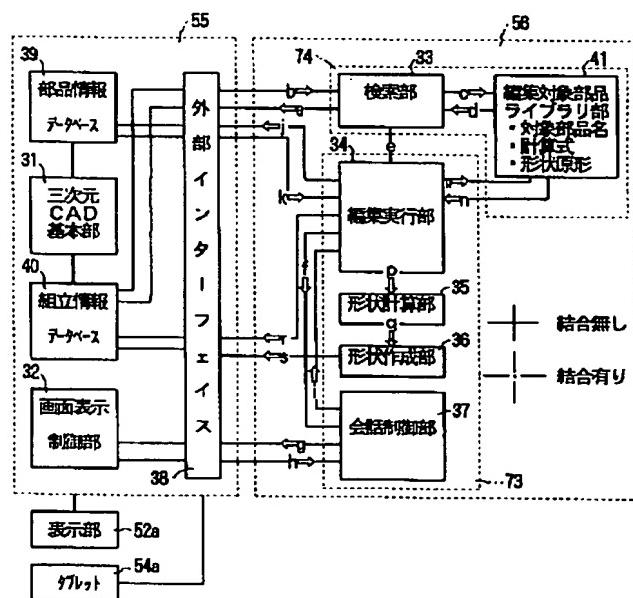


[Drawing 8]

第一の実施例に係る編集対象部品の例を示す図

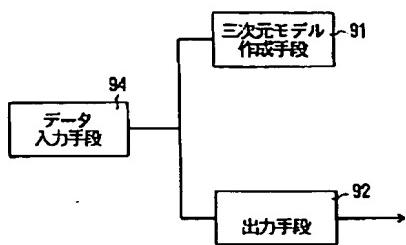


[Drawing 9]
第二の実施例に係るブロック図

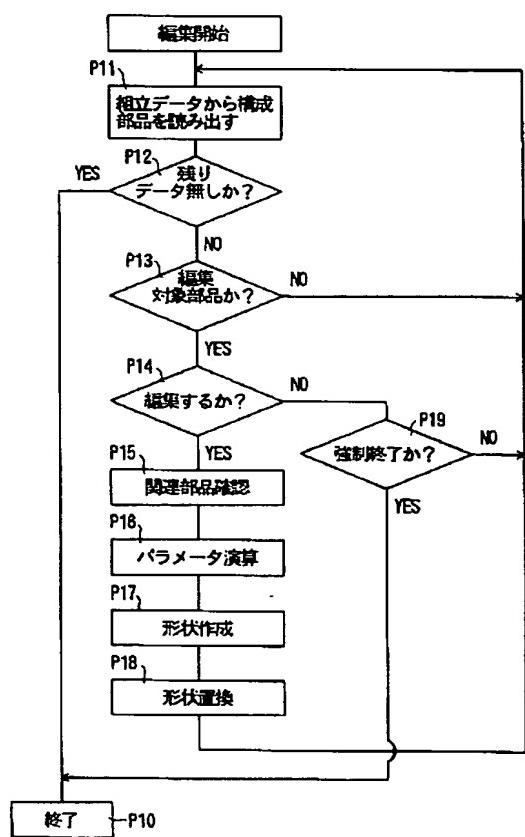


[Drawing 12]

従来例に係るブロック図

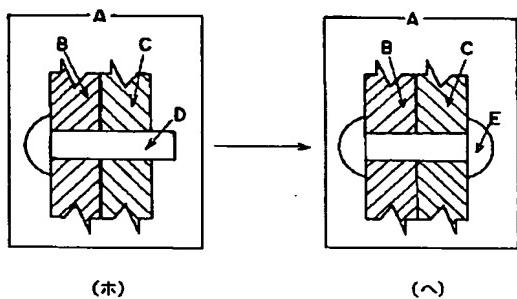
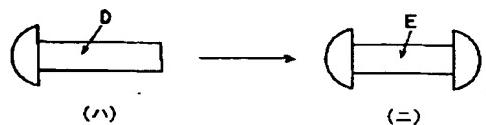
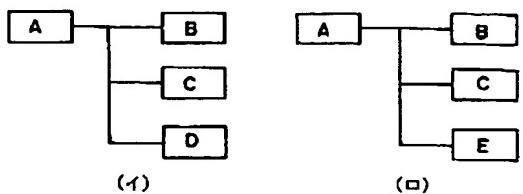


[Drawing 10]
第二の実施例に係る流れ図



[Drawing 11]

第二の実施例に係る置換例を示す図



[Translation done.]

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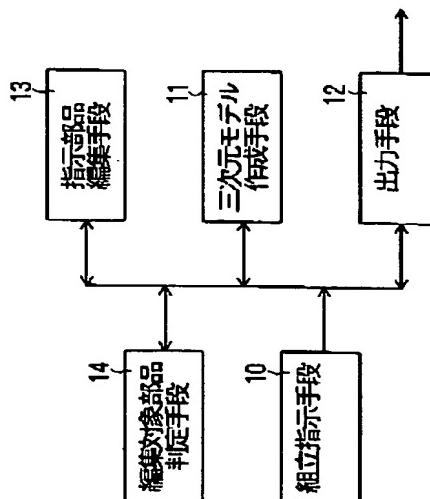
(54)【発明の名称】 三次元モデル作成装置及び方法

(57)【要約】

【目的】 三次元の製品モデルを作成して表示する三次元モデル作成装置及び方法に関し、より現実に近い高品質の三次元モデルの作成を容易に、効率良く、且つ迅速に行うこととする。

【構成】 三次元の製品モデルに組み立てるべき部品モデル毎に、順次組立ての指示を行い、組立ての指示がされた部品モデルが編集対象部品であるか否かの判定を行い、組立ての指示がされた部品モデルが編集対象部品であると判定された場合には、当該部品モデルについて、その組立て前後の関係又は関連する他の部品モデルとの関係に基づいて、組立て後の部品モデルを編集し、各部品の属性情報及び部品間の組立情報に基づいて、組立ての際に指示された部品モデル及び編集された部品モデルを組み込んで三次元の製品モデルを組み立てるように構成する。

第一の発明に係る原理ブロック図



【特許請求の範囲】

【請求項1】 三次元の製品モデルに組み立てるべき部品モデル毎に、順次組立ての指示を行う組立指示手段（10）と、

前記組立指示手段（10）により組立ての指示がされた前記部品モデルが、編集対象部品か否かの判定を行う編集対象部品判定手段（14）と、
組立ての指示を行った部品モデルが編集対象部品であると判定された場合には、当該部品モデルについて、その組立て前後の関係又は関連する他の部品モデルとの関係に基づいて、組立て後の部品モデルに編集する指示部品編集手段（13）と、

各部品の属性情報及び部品間の組立情報に基づいて、前記組立指示手段（10）の指示した部品モデル及び前記指示部品編集手段（13）により編集された部品モデルを組み立てて三次元の製品モデルを作成する三次元モデル作成手段（11）と、

三次元モデル作成手段（11）により作成された三次元の製品モデルについて、表示等の出力を行う出力手段（12）とを有することを特徴とする三次元モデル作成装置。

【請求項2】 三次元の製品モデルに組み立てられた部品モデル毎に、順次指定を行う部品指定手段（20）と、

前記部品指定手段（20）により指定された前記部品モデルが、編集対象部品か否かの判定を行う編集対象部品判定手段（14）と、

指定された部品モデルが編集対象部品であると判定された場合には、当該部品モデルについて、その組立て前後の関係又は関連する他の部分との関係に基づいて、組立て後の部品モデルに編集する指定部品編集手段（23）と、

各部品の属性情報及び部品間の組立情報に基づいて、三次元の製品モデルを作成するとともに、当該製品モデルに組み立てられた部品モデルのうち、前記編集対象部品判定手段（14）により編集対象部品と判定された部品モデルを、前記指定部品編集手段（23）により編集された部品モデルに置き換える三次元モデル作成手段（21）と、

三次元モデル作成手段（21）により作成された製品モデルについて、表示等の出力を行う出力手段（12）とを有することを特徴とする三次元モデル作成装置。

【請求項3】 三次元の製品モデルに組み立てるべき部品モデル毎に、順次組立ての指示を行い（S1）、組立ての指示がされた部品モデルが編集対象部品であるか否かの判定を行い（S2）、

組立ての指示がされた部品モデルが編集対象部品であると判定された場合には、当該部品モデルについて、その組立て前後の関係又は関連する他の部品モデルとの関係に基づいて、組立て後の部品モデルを編集し（S3）、

各部品の属性情報及び部品間の組立情報に基づいて、組立ての際に指示された部品モデル及び編集された部品モデルを組み込んで三次元の製品モデルを組み立てる（S4）ことを特徴とする三次元モデル作成方法。

【請求項4】 三次元の製品モデルに組み立てられた部品モデル毎に、順次指定を行い（S11）、指定された部品モデルが編集対象部品であるか否かの判定を行い（S12）、

指定された部品モデルが編集対象部品であると判定された場合には、当該部品モデルについて、その組立て前後の関係又は関連する他の部品との関係に基づいて、組立てた後の部品モデルに編集し（S13）、

各部品の属性情報及び部品間の組立情報に基づいて作成された三次元の製品モデルの部品モデルのうち、編集対象部品と判定された部品モデルを、編集された部品モデルに置き換える（S14）ことを特徴とする三次元モデル作成方法。

【0001】

【発明の詳細な説明】

【産業上の利用分野】 本発明は、三次元モデル作成装置及び方法に係り、特に、三次元の製品モデルを作成して表示させる三次元モデル作成装置及び方法に関する。本発明は、ワークステーションレベルの三次元CADにより、製品開発を行う分野で、設計部門では製品モデルの設計及び組立てモデル上での干渉チェック作業の精度向上、製造部門では組立てシミュレーション作業の効率化に役立つ。

【0001】

【従来の技術】 従来、図12に示すような三次元CADによる三次元モデル作成装置があった。従来例に係る三次元CADは、同図に示すように、三次元の製品モデルに関するデータの入力や指示を行うデータ入力手段94と、当該データ入力手段94により入力され又は予め格納された各部品の属性情報又は部品間の組立情報に基づいて三次元の製品モデルを作成する三次元モデル作成手段91と、作成された三次元の製品モデルの表示等の出力を行う出力手段92とを有するものである。

【0002】

【発明が解決しようとする課題】 さて、従来例に係る三次元CADによる設計では、単体部品モデルの三次元形状が組立て後に変形する場合、操作者が変形する部品モデルを製品モデルの中から検索して、前記データ入力手段94により、個々にその変形後のデータを入力して前記三次元モデル作成手段91によりモデル自体を作り直す必要があった。又は、予め変形後のモデルを各種作っておいて、組立て後に変形する部品モデルを製品モデルの中から検索して、変形前の部品モデルを、その変形の条件にあった部品モデルを選んで取り替える作業が必要となる。そのため、使用者の負担が増えるという問題点を有していた。

【0003】そこで、本発明では、従来技術の問題点を解決する為、組立て前後でモデルの形状が変わる部品種（編集対象部品種）を自動的に判定し、組立ての前後でモデルの形状の変わった部品モデルに対しては、その組立ての前後の関係又は関連する他の部品モデルとの関係に基づいて、自動的に組立て後の部品モデルを編集して、三次元の製品モデルを作成させる。これにより組立ての前後で変わった部品モデルを取り付ける箇所での条件に従った最適形状を具現させて、チェックを実際に組み立てた場合と同様に行って、より現実に近い高品質の三次元モデルの作成を容易に、効率良く、且つ迅速に行うことの目的としてなされたものである。

【0004】

【課題を解決するための手段】以上の技術的課題を解決するため、第一の発明は、図1に示すように、三次元の製品モデルに組み立てるべき部品モデル毎に、順次組立ての指示を行う組立指示手段10と、前記組立指示手段10により組立ての指示がされた前記部品モデルが、編集対象部品か否かの判定を行う編集対象部品判定手段14と、組立ての指示を行った部品モデルが編集対象部品であると判定された場合には、当該部品モデルについて、その組立て前後の関係又は関連する他の部品モデルとの関係に基づいて、組立て後の部品モデルに編集する指示部品編集手段13と、各部品の属性情報及び部品間の組立情報に基づいて、前記組立指示手段10の指示した部品モデル及び前記指示部品編集手段13により編集された部品モデルを組み立てて三次元の製品モデルを作成する三次元モデル作成手段11と、三次元モデル作成手段11により作成された三次元の製品モデルについて、表示等の出力を行う出力手段12とを有するものである。

【0005】第二の発明は、図2に示すように、三次元の製品モデルに組み立てられた部品モデル毎に、順次指定を行う部品指定手段20と、前記部品指定手段20により指定された前記部品モデルが、編集対象部品か否かの判定を行う編集対象部品判定手段14と、指定された部品モデルが編集対象部品であると判定された場合には、当該部品モデルについて、その組立て前後の関係又は関連する他の部分との関係に基づいて、組み立て後の部品モデルに編集する指定部品編集手段23と、各部品の属性情報及び部品間の組立情報に基づいて、三次元の製品モデルを作成するとともに、当該製品モデルに組み立てられた部品モデルのうち、前記編集対象部品判定手段14により編集対象部品と判定された部品モデルを、前記指定部品編集手段23により編集された部品モデルに置き換える三次元モデル作成手段21と、三次元モデル作成手段21により作成された製品モデルについて、表示等の出力を行う出力手段12とを有するものである。

【0006】第三の発明は、図3に示すように、三次元

の製品モデルに組み立てるべき部品モデル毎に、順次組立ての指示を行い（S1）、組立ての指示がされた部品モデルが編集対象部品であるか否かの判定を行い（S2）、組立ての指示がされた部品モデルが編集対象部品であると判定された場合には、当該部品モデルについて、その組立て前後の関係又は関連する他の部品モデルとの関係に基づいて、組立て後の部品モデルを編集し（S3）、各部品の属性情報及び部品間の組立情報に基づいて、組立ての際に指示された部品モデル及び編集された部品モデルを組み込んで三次元の製品モデルを組み立てる（S4）ことである。

【0007】第四の発明は、図4に示すように、三次元の製品モデルに組み立てられた部品モデル毎に、順次指定を行い（S11）、指定された部品モデルが編集対象部品であるか否かの判定を行い（S12）、指定された部品モデルが編集対象部品であると判定された場合には、当該部品モデルについて、その組立て前後の関係又は関連する他の部品との関係に基づいて、組立てた後の部品モデルに編集し（S13）、各部品の属性情報及び部品間の組立情報に基づいて作成された三次元の製品モデルの部品モデルのうち、編集対象部品と判定された部品モデルを、編集された部品モデルに置き換える（S14）ことである。

【0008】ここで、「編集」とは、製品モデルを組み立てる際に、組み立てる前の形状を組み立てた後の形状に変形させることをいう。例えば、リベットの頭をかしめて関連する板を結合させる場合に、組み立てる前の形状をかしめた後の形状に変形させることをいう。「編集対象部品」とは、製品モデルを組み立てる際に、組み立てる前と後とで形状が異なる部品をいう。例えば、リベット、ボルトとナット、若しくは半田のような結合部材、スプリング、ワッシャ、若しくはゴム等の弾性部材、動力伝達系のベルト等の間接伝動部材、水銀等の流動体を包含する部材、組立により変形する可塑性部材、可撓性部材、又は、リード線が設けられた回路等がある。

【0009】「その組立て前後の関係」とは、編集前の形状と編集後の形状との相違点をいい、「関連する他の部品」とは、編集対象部品と接触等の関連をもつ部品であって、以下「関連部品」という。例えば、編集対象部品がリベットの場合には、当該リベットにより結合される複数枚の板状の部品をいう。

【0010】

【作用】統いて、第一の発明及び第三の発明について説明する。図1及び図3に示すように、ステップS1で、前記組立指示手段10により、製品モデルを形成する部品モデルについて、順次製品モデルに組み立てるために、出力手段12の画面上等で指示する。その際、前記編集対象部品判定手段14は、前記組立手段10により組立ての指示のあった前記部品モデル毎に、編集対象部

品か否かの判定を行う。

【0011】ステップS2で、組立ての指示を行った部品モデルが編集対象部品であると判定された場合には、前記指示部品編集手段13は、当該編集対象部品について、その組立ての前後の関係又は関連部品との関係に基づいて、組立て後の部品モデルを編集する。ステップS3で、与えられた作成対象の各部品の属性情報及び部品間の組立情報に基づいて、組立ての際に指示された部品モデルを作成するとともに、作成された部品モデル又は編集された部品モデルを組み込んで製品モデルを組み立てる。組み立てられた製品モデルは前記出力手段12により画面上に表示されたり、印刷出力されることになる。

【0012】統いて、第二の発明及び第四の発明の作用について説明する。図2及び図4に示すように、本発明にあっては、前述したものと異なり、ステップS11で、前記部品指定手段20により、三次元の製品モデルに組み立てられた部品モデル毎に、順次指定を行う。すると、ステップS12で、前記編集対象部品判定手段14により、指定された部品モデルが、編集対象部品か否かの判定を行う。

【0013】ステップS13で、指定された部品モデルが編集対象部品であると判定された場合には、当該部品モデルについて、その組立て前後の関係又は関連部品との関係に基づいて、組み立てた後の部品モデルに編集する。ステップS14で、組み立てられた製品モデルの部品モデルのうち、編集対象部品と判定された部品モデルを、編集された部品モデルに置き換える。置き換えられた製品モデルは前記出力手段12から表示等の出力がなされる。

【0014】

【実施例】統いて、本発明の実施例について図面に基づいて説明する。図5は、本実施例に係る三次元モデル作成装置及び方法に関する機器構成ブロック図を示す。同図に示すように、本実施例では、ハードウエアとしては、当該三次元モデル作成装置に関する種々の制御を行うC P U及びメモリ51と、作成された三次元モデル等のデータについて表示等の出力をを行う出力手段52と、各種のデータが格納されているファイル53と、操作者により画面上で種々の指定や指示を行う機能をもつタブレット54a及びデータの入力をを行うキーボード54等や書き入力可能な入力手段54とがバスにより接続されたものである。

【0015】図5に示すように、C P U及びメモリ51には、三次元モデルの作成を行う際に用いる基本的なプログラムにより実現される機能をもつ三次元C A D基本部31と、作成された三次元モデルや種々の情報について表示部52aに表示させる制御を行う画面表示制御部32と、指示により後述する編集対象部品ライブラリ部41に対し編集対象部品の検索を行う検索部33と、編

集の実行を指示する編集実行部34と、形状の計算を行う形状計算部35と、形状モデルの作成を行う形状作成部36と、メッセージを表示したり操作者から選択やキー入力情報を読み取る会話制御部37と、三次元C A Dシステム55と利用者側でカスタマイズすることができるアプリケーション部56との間の接続の制御、即ち、三次元C A Dシステム55の内部ファイルに記録されたモデル情報（形状、位置、色その他の属性）を外部に取り出し、加工して再度内部に戻す機能をもつ外部インターフェース部38とを有する。

【0016】また、前記出力手段52には、表示部52aと、計算結果のリストをパラメータと共に表示するプリンタ52bとを有する。前記ファイル53には、部品情報データベース39と、組立情報データベース40と、編集対象部品ライブラリ部41とを有する。ここで、当該編集対象部品ライブラリ部41には、対象部品名、計算式及び形状原形等の情報が格納されている。

【0017】統いて、第一の実施例について説明する。第一の実施例に係る三次元モデル作成装置は、前述した図5に示した機器を用いて図6に示すように構成したものである。本実施例に係る三次元モデル作成装置にあっては、三次元の製品モデルに組み立てるべき部品モデル毎に、順次組立ての指示を行う組立指示手段に相当する前記タブレット54aと、当該タブレット54aにより組立ての指示のあった前記部品モデルが、編集対象部品か否かの判定を行う編集対象部品判定手段64とを有する。

【0018】また、本実施例に係る三次元モデル作成装置は、組立ての指示を行った部品モデルが編集対象部品であると判定された場合には、当該部品モデルについて、その組立て前後の関係又は関連部品モデルとの関係に基づいて、組立て後の部品モデルに編集する指示部品編集手段63と、各部品の属性情報及び部品間の組立情報に基づいて、前記組立指示手段であるタブレット54aの指示した部品モデル及び前記指示部品編集手段63により編集された部品モデルを組み立てて三次元の製品モデルを作成する三次元モデル作成手段に相当する三次元C A Dシステム55と、三次元モデル作成手段により作成された三次元の製品モデル等について、表示を行う表示部52aとを有する。

【0019】さらに、前記編集対象部品判定手段64には、前記検索部33と、編集対象部品ライブラリ部41とを有し、前記指示部品編集手段63には、編集実行部34と、形状計算部35と、形状作成部36と、会話制御部37とを有する。また、前記三次元C A Dシステム55は前記部品情報データベース39と、三次元C A D基本部31と、組立情報データベース40と、画面表示制御部32と、外部インターフェース38とに相当し、アプリケーション部56は、前記指示部品編集部63及び編集対象部品判定部64とを有するものである。

【0020】続いて、第一の実施例に係る三次元モデル作成装置及び方法の動作について、図7に基づいて説明する。図7の流れ図中、点線で囲まれたステップP1～P5が本実施例の機能に関する部分で、他は通常の三次元CADでも共通の機能である。

【0021】図7に示すように、組立てが開始されて、前記タブレット54a等により順次組立ての対象となる部品モデルの選択の指示があると、部品情報データベース39から選択された部品モデルに関する部品情報が読み出される(a)。すると、ステップP1で、外部インターフェース38を経由して前記編集対象部品判定手段64の検索部33を起動し、編集対象部品ライブラリ部41に選択された部品名称をキーワードにして検索を行う(b)。

【0022】ここで、「部品名称」とは以下のような規則で統一的に、リベット等の編集対象部品に割り当てられた当該編集対象部品を識別する識別子であって、検索の便宜を考慮したものである。例えば、部品名称は、リベットなら“L1B1XY”である。ここで、“○○○○○○”の部品名称のうち、最初の3文字は部品の種類、即ち、部品種を表し、例えば、リベット、ボルトとナット、半田等の結合部材、スプリング、ワッシャ、ゴム等の弾性部材、ベルト、鎖等の間接伝動部材、可塑性部材、可撓性部材、水銀等の流動体を用いた部材、又はリード線を有する回路等がある。

【0023】また、次の1桁の数字は、同一部品種の中の分類であり、例えば、部品種がリベットの場合には丸リベットや皿リベットがある。さらに、次の2文字は、追い番であり、同一分類の中で更に分類が必要な場合に付加されるものである。この部品名称を用いることにより、編集対象部品か否かの判定を容易に行うことができる。

【0024】検索結果(c)が編集対象部品でなければ、通常の組立て処理で良いため、ステップP6に進み、三次元CADシステム55の画面表示制御部32を介して、当該部品モデルを三次元モデルに組み込んだものを前記表示部52aに表示させる。

【0025】一方、ステップP1で編集対象部品と判定された場合には、ステップP2に進み、前記検索部33は、会話制御部37を通じて三次元CADシステム55の画面表示制御部32を介して、表示部52aの画面に操作者に対して、編集するか否かを一旦問い合わせる(f)。これは、場合によっては原形のままの方が良い場合もあるので念のために確認を入れるためである。

【0026】問い合わせの結果(g)が編集しないと回答された場合には再び(f)を経由して操作者へ編集回避の通知を出してステップP6に進み、当該部品を三次元モデルに組立て、次の部品選択まで待機する。このような編集対象部品の例として丸リベットの場合を図8に示す。同図(イ)はカシメ前の形状を示す丸リベット1で

あり、同図(ロ)は丸リベット1を丸カシメした形状を示し、同図(ハ)は皿カシメした形状を示す。尚、同図(ロ)と(ハ)の符号2及び符号3はカシメられて結合した個々の部品、いわゆる「関連した他の部品」を表す。このように、リベットは完成品モデルに組み立てる場合には、リベットのカシメ前と後及びカシメかたにより形状が変わる。

【0027】一方、ステップP2で編集すると選択した場合には、ステップP3に進み、会話制御部37から

(f)を経由して、操作者に対して、前記表示部52aの画面上で、「関連した他の部品」である図8に示した符号2及び符号3の選択を促すと同時に(h)を経由して編集実行部34を起動し、(i)を経由して部品情報データベース39から指示された関連部品情報を読み取る。又は、操作者は対象となる関連した他の部品である図8の符号2及び符号3に関する数値L1, L2, Ld等の数值を入力する。

【0028】ステップP4で、読みとられた関連する部品情報は、(j)を経由して形状計算部35へ必要な寸法データを取り込まれ、形状計算部35は、編集実行部34から(k)を介して編集対象部品ライブラリ部41から計算式を、(m)を介して取り込み形状計算を行う。

【0029】計算は、図8に示すように、関連部品である部品2及び部品3の夫々の厚みL1とL2を予め加味し、丸カシメだと図8の(ロ)のように、皿カシメだと同図(ハ)のような頭の形状になるように、同図(イ)のリベットの形状を基に加工した丸リベット1a, 1bに自動的に置き換えるものである。

【0030】具体的には次のように行う。図8に示すように、関連部品の形状原形データに相当するその厚さを夫々L1とL2を読み込む。変形による長さの変化は以下のようである。即ち、丸カシメした丸リベット1aの場合には、その胴の長さLbは、

$$Lb = L1 + L2 \quad \cdots \text{式1}$$

【0031】一方、皿カシメした丸リベット1bの場合には、その胴の長さLcは、関連部品の厚さを夫々L1とL2とした場合には、関連部品3のカシメ用皿もみの厚さを加味し、

$$Lc = L1 + L2 - Ld \quad \cdots \text{式2}$$

40 を用いて計算する。この条件式は予め前記編集対象部品ライブラリ部41の中に登録されている。

【0032】ステップP5で、前記形状原形データを(n)を介して編集対象部品ライブラリ部41から取り込むとともに、前記形状計算部35により得られた計算結果を(p)を経由して得た形状作成部36は、最終形状を作成する。形状の作成は、前述した丸リベットの場合には、次のように、丸カシメと皿カシメとで夫々頭の形状が異なる。丸カシメの丸リベット1aについては、丸リベットの反対側の形状からミラーさせた形状を作成することにより行われ、皿カシメの場合には、関連部品3の

皿もみされた形状と合同の形状を生成することにより行われる。

【0033】当該形状生成の条件も予め三次元CADの中の参照可能な前記編集対象部品ライブラリ部41に登録させておく。ここで、「モデル形状を作成する処理」というのは、予め変形モデルの原形が用意してあって、個々の寸法値だけが代入できるモデルとなっており、ステップP4で計算して得た結果の数値を当てはめるだけで容易に形状が作成できる。ステップP6で、作成された最終形状は、(q)を経由して、三次元CAD基本部31へ渡され、当該部品形状を使って組立てが行われる。以上のステップP1～ステップP6は組立てが終了するまで繰り返される。

【0034】続いて、第二の実施例について説明する。第二の実施例は、第一の実施例と異なり、組立てが完了した三次元モデルに対し編集を行うプログラムを起動するものである。第二の実施例に係る三次元作成装置は、図9に示すように、製品モデルに組み立てられた部品モデル毎に、順次指定を行う部品指定手段であるタブレット54aと、当該タブレット54aにより指定された前記部品モデルが、編集対象部品か否かの判定を行う編集対象部品判定手段74と、指定された部品モデルが編集対象部品であると判定された場合には、当該編集対象部品について、その組立て前後の関係又は関連する他の部分との関係に基づいて、組み立て後の部品モデルに編集する指定部品編集手段73とを有する。

【0035】また、第二の実施例に係る三次元モデル作成装置は、各部品の属性情報及び部品間の組立情報に基づいて、三次元の製品モデルを作成するとともに、当該製品モデルに組み立てられた部品モデルのうち、前記編集対象部品判定手段74により編集対象部品と判定された部品モデルを、前記指定部品編集手段73により編集された部品モデルに置き換える三次元モデル作成手段である三次元CADシステム55と、三次元CADシステム55により作成された三次元の製品モデル等について、表示を行う表示部52aとを有する。

【0036】続いて、第二の実施例に係る動作を図10に基づいて説明する。図10に示すように、組立後の編集を除いて一旦、組立てが完了した三次元の製品モデルに対し編集を行うプログラムを前記タブレット54a等により起動すると、ステップP11で、前記編集対象部品判定部56である検索部33は、経路(a)及び経路(b)を介して組立情報データベース40から三次元の製品モデルを構成する部品モデルの部品情報を順番に読み出す。

【0037】読み出しを行った際に、ステップP12で、全てのデータを読み終えたか否かをチェックする。まだ、読み出しを待つ部品データが存在する場合には、ステップP13で、当該編集対象部品判定手段74の検索部33は、読み出された部品データが編集対象部品か

否かの判定を行う。

【0038】ここで、検索部33による編集対象部品か否かの判定は次のようにして行う。前記組立情報データベース40から読み出された部品情報に含まれる前記部品名称(b)をキーワードにして編集対象部品ライブラリ部41を検索することにより行うものであり、前記部品名称を編集対象部品ライブラリ部41へ送付し(c)、編集対象部品か否かを照合することにより行う。

【0039】編集対象部品でないと判定された場合に10は、検索部33は、次の部品を(a)経路を介して読み出しに行くため、ステップP11に戻る。ステップP13で編集対象部品であると判定された場合には、ステップP14で、操作者に対し、編集するか否かの選択を仰ぐため、(e)の経路を介して、編集実行部34を起動し、(f)経路で、会話制御部37を起動し、(g)経路を介して三次元CADシステム55の表示部52aの画面上に編集して良いか否かの指示を操作者に仰ぐ。

【0040】編集しないという選択がされた場合には、好ましくは、ステップP19に示すように、会話制御部2037から(i)を経由して編集実行部34へ戻し、強制終了するか否かを(f)又は(g)を経由して、再度表示して操作者の回答を待つ。強制終了を行うと回答された場合には、(i)と(h)を経由して編集実行部34へその旨が通知され編集処理動作を終了する。強制終了を行わないと回答された場合にはステップP11に戻り、次のデータの読み出し動作に移る。ステップP14で、編集するという選択がされた場合には、ステップP15で、編集実行部34から部品情報データベース39へ対象となる前記関連部品の寸法(厚み)を読み取り(j)、その結果を記録する(k)。

【0041】ステップP16で、前記編集実行部34は形状計算部35を起動し、同様に編集対象部品ライブラリ部41から対象部品(この場合はリベット形状及び計算式等)を(m)及び(n)を介して得た情報を元に変形パラメータの計算を実施させる。ステップP17で、その結果を形状作成部36へ渡し(q)、変形後の形状を生成する。

【0042】ステップP18で、形状作成部36により形状を完成すると編集実行部34から三次元CADシステム55の組立情報データベース40へアクセスし(r)40、形状作成部36は変更前のモデルと変更後の形状を経路(s)を用いて読み出し置換する。ここで、「置換」というのは、図11(イ)に示すように、AはB、C、Dで組み立てたものとした場合に、本実施例に係る機能(指定部品編集手段)により編集を行うことにより“D”を“E”に換えて、同図(ロ)に示すように構成することをいう。

【0043】さらに具体的には、同図(ホ)に示すように、Aモデルとして、関連部品B(板状部材)、関連部品C(板状部材)及び部品D(リベット)からなる編集

前の構成を、同図(ヘ)に示すように、そのうちの部品Dを同図(ハ)に示す変形前のリベットを同図(ニ)に示す変形後のリベットEに、同図(ホ)のAモデル中の部品Dの場所で置き換えることをいう。尚、ステップP18の後、前記編集対象部品判定手段74は次のデータの読み出しへ移る。

【0044】以上の説明では、編集対象部品として、リベットを、関連部品として2枚の板状部材の場合について説明したが、3枚以上の板状部材についても可能であることはいうまでもない。また、リベットの他に、組立前のボルトとナットに対し、組立後の結合状態にあるボルトとナットの場合、また、関連部品としての板状の部材にも適用される。その他、半田付け、溶接、折り曲げによる結合にも適用される。

【0045】さらに、組立前の変形のない、スプリング、ワッシャ、ゴム等の弾性部材に対し、組立てた後の変形したスプリング、ワッシャ、ゴム等の弾性部材にも適用される。その他、編集対象部品として、動力伝達系の間接伝動部材にも適用され、また、可撓性部材や、可塑性部材、液体等の流動体を包含する部材、又はリード線をもつ回路等にも適用される。以上説明したように、各実施例にあっては、組立前後で形状が異なる編集対象部品の形状変化の条件式等を前記編集対象部品ライブラリ部にもつようしている。従って、編集対象部品の更新や削除が容易であり使い勝手が良く、また、高速に処理を行うとともに、設定品質の高い三次元モデルを提供する。

【0046】また、各編集対象部品には、統一した部品名称を付加し、当該部品名称を検索のキーとして、予め基本形状と変形時の条件式を登録し、登録時点で決定したユニークな部品名を使うことにより、該部品を組み立てる際に自動的に変形形状を抽出して取り付ける箇所での条件に従った最適形状を具現させることができる。従って、編集対象部品か否かの判定を容易にして、高速に処理を行うことができる。以上説明したように、各実施例にあっては、三次元CADを使って立体的な製品モデルを作成する場合、個々の単一部品モデルを集めて組み立てる際に単体で存在している場合と組み込まれた場合とでは形状が異なる編集対象部品に対して、形状変形の法

則を予めプログラム化しておき、組立て段階で、その法則に則り組立て後の形状を自動的に計算してモデルを変形し所定の位置に具現させる。これにより三次元CADで製品モデルを作成する場合に、より現実の製品に近い表現となりしかも自動的に実現されることにより操作の手間も省かれる。

【0047】

【発明の効果】以上のように本発明によれば、三次元CADによる三次元の製品モデルの作成の際に、部品モデルの組立ての前後で形状が異なる編集対象部品については、編集を行うことにより、実際に組立てたものと同じ形状を自動的に具現化するようにしている。従って、部品モデルを製品モデルに組み立てた際に生ずる干渉チェックや間隙チェックを実際に組み立てた場合と同様に実施することができるので、設計の改善策を与えることにより、より正確な設計の支援を可能とし、より現実に近い高品質の三次元モデルの作成を容易に操作性良く、効率良く、且つ迅速に行うことができる。

【図面の簡単な説明】

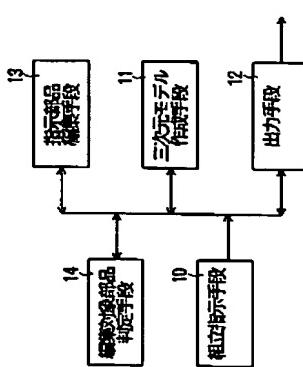
- 20 【図1】第一の発明の原理ブロック図
- 【図2】第二の発明の原理ブロック図
- 【図3】第三の発明の原理流れ図
- 【図4】第四の発明の原理流れ図
- 【図5】実施例に係る機器構成ブロック図
- 【図6】第一の実施例に係るブロック図
- 【図7】第一の実施例に係る流れ図
- 【図8】第一の実施例に係る編集対象部品の例を示す図
- 【図9】第二の実施例に係るブロック図
- 【図10】第二の実施例に係る流れ図
- 【図11】第二の実施例に係る置換例を示す図
- 【図12】従来例に係るブロック図

【符号の説明】

- 10 組立指示手段
- 11, 21 三次元モデル作成手段
- 12, 52 出力手段
- 13 指示部品編集手段
- 14 編集対象部品判定手段
- 20 部品指定手段

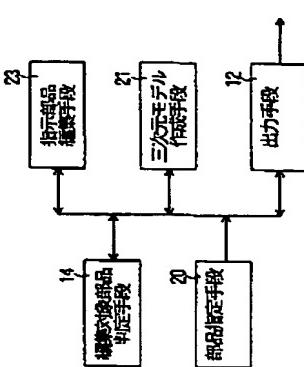
【図 1】

第一の発明に係る原理ブロック図



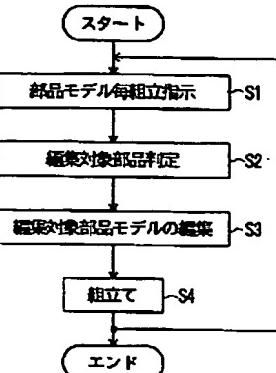
【図 2】

第二の発明に係る原理ブロック図



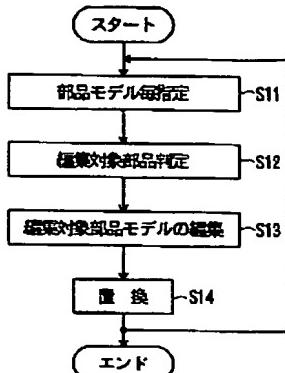
【図 3】

第三の発明に係る原理流れ図



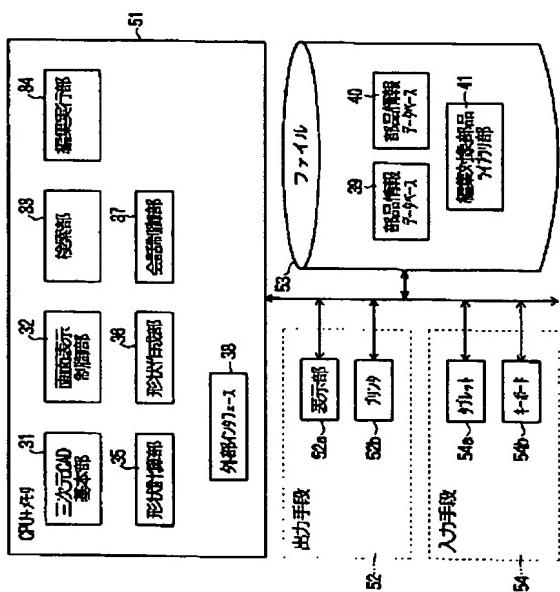
【図 4】

第四の発明に係る原理流れ図



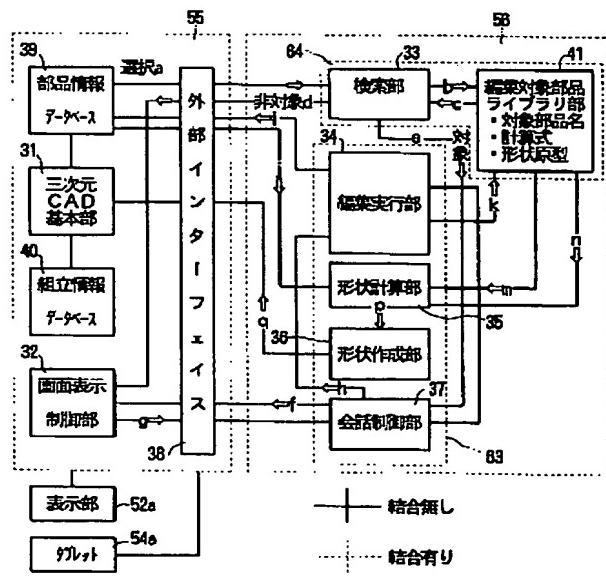
【図 5】

実施例に係る機器構成ブロック図

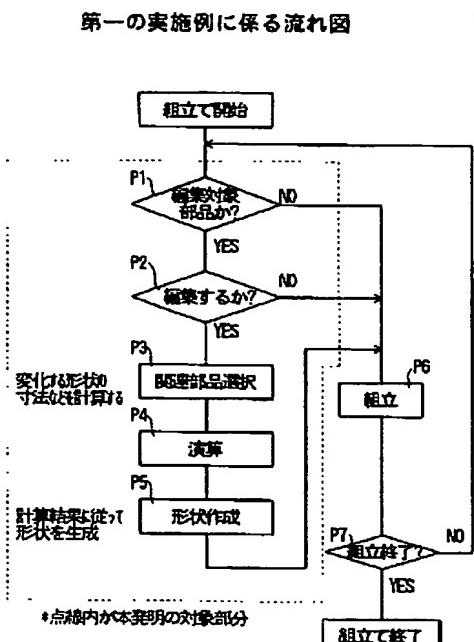


【図 6】

第一の実施例に係るブロック図

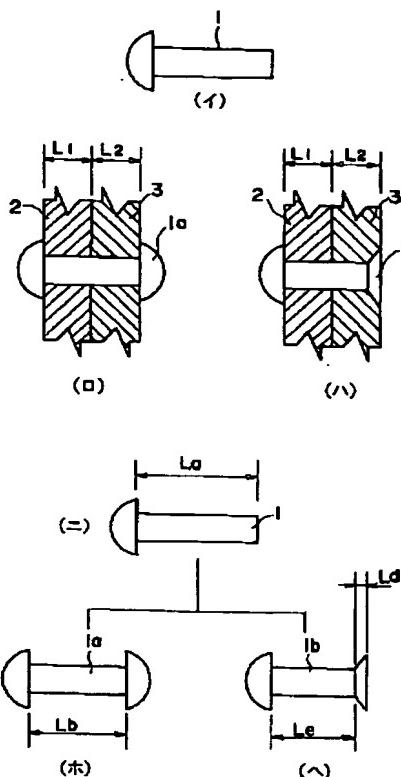


【図 7】



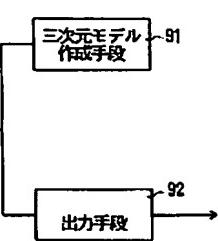
【図 8】

第一の実施例に係る編集対象部品の例を示す図



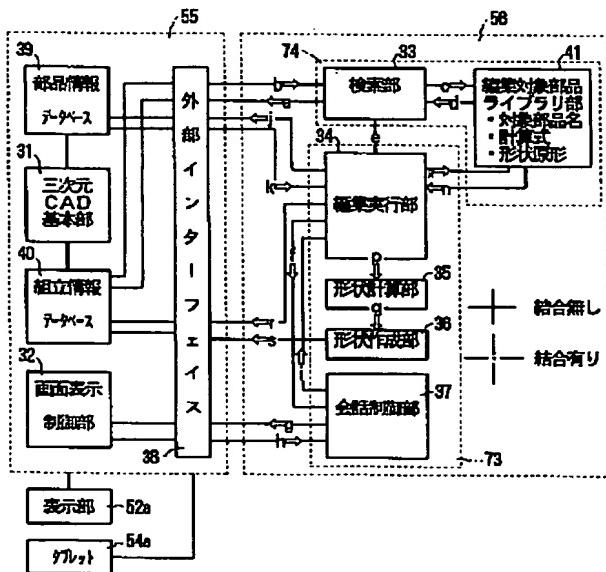
【図 12】

従来例に係るブロック図



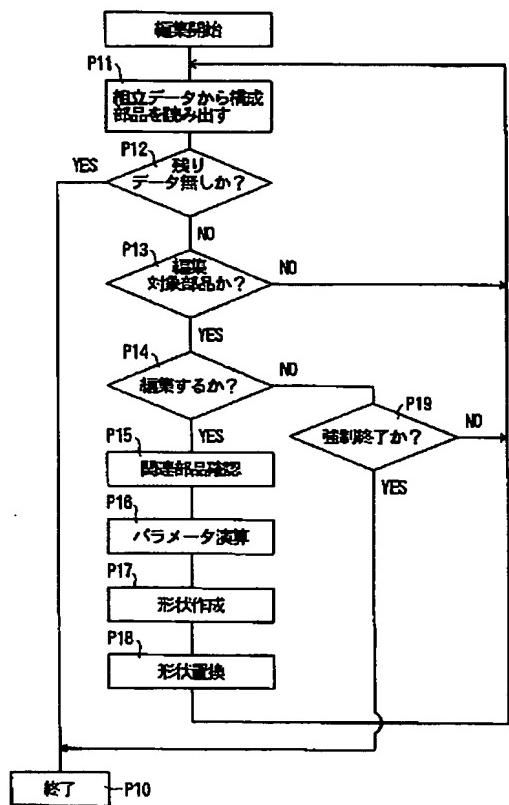
【図 9】

第二の実施例に係るブロック図



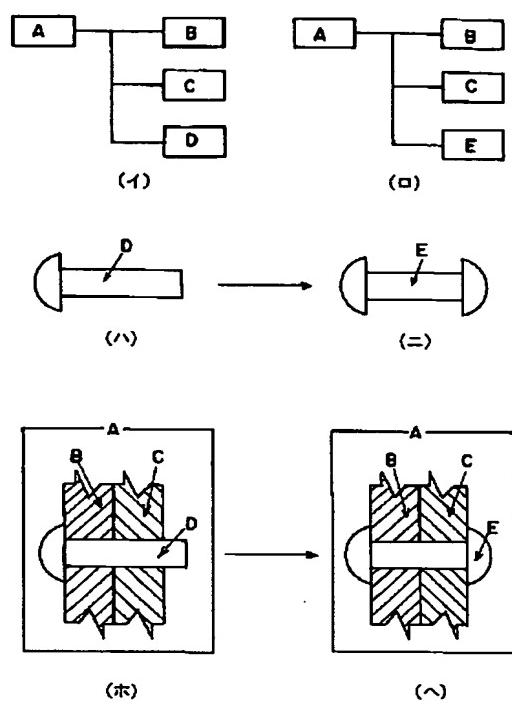
【図10】

第二の実施例に係る流れ図



【図11】

第二の実施例に係る置換例を示す図



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